

Remarks:

Reconsideration of the application, as amended herein, is respectfully requested.

Claims 9 and 10 are presently pending in the application.

Claims 1 - 8 have been canceled. New claims 9 and 10 have been added.

On page 2 of the Office Action, it was stated that a certified copy of the foreign priority document was not yet available. In the event that Applicants find that the certified copy of the priority document was not previously filed, Applicants will file one prior to issue.

In item of the Office Action, claims 5, 7 and 8 were rejected under 35 U.S.C. § 103(a) as allegedly being obvious over U. S. Patent No. 5,610,415 to Schulze ("SCHULZE") in view of Rosling et al., "A Study of Design Influence on Anode-Shorted GTO Thyristor Turn-On and Turn-Off", IEEE Transactions on Power Electronics, Vol. 9, No. 5, September 1994, pages 514 - 521 ("ROSLING").

Applicants respectfully traverse the above rejections.

More particularly, Applicants' new claim 9 recites, among other limitations:

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

a stop zone in front of said emitter region, the stop zone and said emitter region having mutually opposite conductivities, the stop zone including sulfur atoms with at least one energy level within the band gap of the semiconductor and at least 200 meV away from both a conduction band and a valence band of the semiconductor, the stop zone having a doping profile of sulfur atoms such that the stop zone is only partially electrically active in the on-state and fully electrically active in the off-state for carriers emitted by the emitter region. [emphasis added by Applicants]

Similarly, Applicants' new claim 10 recites, among other limitations:

a stop zone in front of said emitter region, the stop zone and said emitter region having mutually opposite conductivities, the stop zone including selenium atoms with at least one energy level within the band gap of the semiconductor and at least 200 meV away from both a conduction band and a valence band of the semiconductor, the stop zone having a doping profile of selenium atoms such that the stop zone is only partially electrically active in the on-state and fully electrically active in the off-state for carriers emitted by the emitter region. [emphasis added by Applicants]

The further language of new claims 9 and 10 (i.e., "the stop zone having a doping profile. . . ."), is supported by the specification of the instant application, for example, by the doping profile shown in Fig. 2 of the instant application, as well as, by paragraphs [0024]-[0026] of the published patent application (i.e., "The doping profile of the circuit element according to FIG. 1 is represented in FIG. 2").

Appl. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

The **SCHULZE** and **ROSLING** references fail to teach or suggest all limitations of Applicants' claims, whether taken alone or in combination. More particularly, neither the **SCHULZE** reference, nor the **ROSLING** reference, teach or suggest, among other limitations of Applicants' claims, Applicants' particularly claimed use of selenium (i.e., claim 10) or sulfur (i.e., claim 9). For example, neither the **SCHULZE** reference, nor the **ROSLING** reference, teach or suggest, among other limitations of Applicants' claims, a power semiconductor element including an emitter region and a stop zone in front of the emitter region, the stop zone including either sulfur atoms (claim 9) or selenium atoms (claim 10) with at least one energy level within the band gap of the semiconductor and **at least 200 meV away from** both a conduction band and a valence band of the semiconductor, **the stop zone having a doping profile of sulfur** (claim 9) **or selenium atoms** (claim 10) **such that the stop zone is only partially electrically active in the on-state and fully electrically active in the off-state for carriers emitted by the emitter region.**

With regard to Applicants' former claims 7 and 8, which are similar to Applicants' present claims 9 and 10, respectively, page 5 of the Office Action stated, in part:

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

from applicant's specification the desirability of both selenium and sulfur as foreign atoms is explained solely on the basis of the adequate minimum distance of 200 meV of the energy levels of selenium and sulfur as donors from the band gap of silicon. Selenium and sulfur share this property with the donors cesium, molybdenum, and barium taught by the prior art in the form of Schulze. **Therefore, the materials selected by the prior art are understood to be suitable to make the device.** Applicant is reminded in this regard that it has been held that mere selection of known materials generally understood to be suitable to make a device, the selection of the particular material being on the basis of suitability for the intended use, would be entirely obvious. In re Leshin 125 USPQ 416. [emphasis added by Applicants]

Thus, Applicants understand that the former claims 7 and 8 were rejected on page 5 of the Office Action as being obvious **over a combination of SCHULZE and ROSLING, modified to use sulfur or selenium** (i.e., since neither SCHULZE, nor ROSLING, specifically teach use of sulfur or selenium in such a device. It was alleged, on page 5 of the Office Action, that such modification would be obvious on the basis that sulfur or selenium would, allegedly, be "suitable for the intended use", since they both have a minimum distance of 200 meV of the energy levels of selenium and sulfur as donors from the band gap of silicon, in view of the disclosure in SCHULZE of using cesium, molybdenum, and barium. **Applicants respectfully disagree.**

More particularly, it would not be obvious to use sulfur or selenium, as substituted for cesium, molybdenum, and barium,

Appl. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

in the system of **SCHULZE**, because, sulfur and selenium, are not suitable for use in the device disclosed in SCHULZE, as will be explained herebelow. Further, the **ROSLING** reference fails to cure this deficiency of **SHULZE**. In fact, as will be explained below, the **SCHULZE** reference actually teaches away from using materials with a relatively low solid solubility, such as sulfur and selenium. Thus, it would not be obvious to use sulfur or selenium in **SHULZE**, even if combined with **ROSLING**, in the manner set forth in the Office Action.

More particularly, col. 2 of **SCHULZE**, lines 3 - 20, state:

In order to avoid these current lines or filaments, at least the second emitter 4 is then doped with additional substances in addition to the standard dopants of the second conductivity type such as, for example, boron. These dopants are selected such that they act as dopants of the first conductivity type above the operating temperature, i.e. at 300° C. and above, whereas they are electrically active to only a relatively slight extent at the normal operating temperature. For the standard case where the second emitter zone is p-doped, these additional substances must thus have donor properties at 300° C. Molybdenum, niobium, cesium or barium, for example, come into consideration as additional substances having such donor properties. In that case wherein the opposite zone sequence is present and the second emitter 4 is n-doped, the additional substances must have acceptor properties above the operating temperature. Cadmium, zinc, gold, or nickel, fix example, are substances suitable therefor.

As such, **SCHULZE** discloses preventing damage to the device by causing a strong local reduction of the emitter efficiency at temperatures above the operating temperature. This is

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

achieved in **SCHULZE**, by doping with substances that act as dopants of the first conductivity type above the operating temperature, and are only slightly electrically active at normal operating temperatures. See, for example, col. 2 of **SCHULZE**, lines 7 - 11. In **SCHULZE**, molybdenum, niobium, cesium, and barium are cited as suitable substances if the emitter zone is p-doped, while cadmium, zinc, gold, or nickel are cited as suitable substances if the emitter zone is n-doped. **SCHULZE** goes on to explain that these additional substances are intended to partially or entirely compensate the doping of the emitter zone above the operating temperature. For example, col. 2 of **SCHULZE**, lines 21-29, state:

What these substances have in common is that, dependent on the doping concentration of the first substances, they partially or entirely compensate the doping of the emitter zone 4 above the operating temperature, i.e. at about 300° C and above. For a complete compensation of the first dopants present in the second emitter zone 4, the doping concentration of the additional substances should be as high as that of the first substances. [emphasis added by Applicants]

In particular, **SCHULZE** discloses that, for complete compensation, "the doping concentration of the additional substances should be as high as that of the first substances". Note that, the "first substances" in **SCHULZE** are understood to be the "standard" dopants, such as boron for a p-type dopant. See, for example, col. 2 of **SCHULZE**, lines 5-7.

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

However, both sulfur and selenium have a solid solubility in silicon that is orders of magnitude lower than the solid solubility of the "standard" dopants, such as boron or phosphorus in silicon. For example selenium and sulfur have a solid solubility in silicon in the range of  $10^{16}$  to  $10^{17}$  atoms/cm<sup>3</sup>, compared to the solid solubility of boron in silicon, which is on the order of  $10^{20}$  atoms/cm<sup>3</sup>. Consequently, sulfur and selenium would not be suitable for achieving a doping concentration approximately as high as the doping concentration of a "standard" dopant, as taught by SCHULTZE. Thus, sulfur and selenium would, according to the explicit teachings of SCHULTZE, be unsuitable for use in the device described in the SCHULZE reference.

In fact, the SCHULZE reference teaches away from using substances, such as sulfur or selenium, that have such a low solid solubility compared with the "standard" dopants, by teaching that the doping concentration of the "additional substances" should be as high as that of the "standard" dopants. Without the doping concentrations being approximately the same, the device described in the SCHULZE reference may be unable to meet its goal of preventing damage to the device, since the local reduction of emitter efficiency at temperatures above the normal operating temperature may not be strong enough to prevent such damage. Thus, by using a

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

substance sulfur or selenium in the device of **SCHULZE**, the device of **SCHULZE** may be rendered unsuitable for its intended purpose.

The **ROSLING** reference, cited in the Office Action in combination with **SCHULZE** against Applicants' former claims, does not cure the above-discussed deficiencies of the **SCHULZE** reference. For the foregoing reasons, among others, Applicants' former claims 7 and 8, the limitations of which are included in Applicants' new claims 9 and 10, respectively, were not rendered obvious by a combination of **SCHULZE** and **ROSLING**, in the manner suggested in the Office Action. As such, Applicants' new claims 9 and 10 are believed to also be patentable over the **SCHULZE** and **ROSLING** references, whether taken alone, or in combination.

Further, Applicants' new claims 9 and 10 also recite, among other limitations, that the stop zone has a doping profile of sulfur atoms (claim 9) or selenium atoms (claim 10), such that the stop zone is only partially electrically active in the on-state and fully electrically active in the off-state for carriers emitted by the emitter region. Neither the **SCHULZE** reference, nor the **ROSLING** reference, teach or suggest, among other limitations of Applicants' claims, a particular doping profile of sulfur or selenium atoms, as currently claimed by

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

Applicants, or any doping profile for sulfur or selenium atoms, at all.

Further, as explained above, such a doping profile of sulfur or selenium atoms would not be suitable for use with the **SCHULZE** reference, because, in teaching **achieving a doping concentration approximately as high as the doping concentration of a "standard" dopant**, the use of sulfur and selenium would, according to the explicit teachings of **SCHULTZE**, be unsuitable for use in the device of **SCHULZE**.  
**achieving a doping concentration approximately as high as the doping concentration of a "standard" dopant**, as taught by **SCHULTZE**. Thus, sulfur and selenium would, according to the explicit teachings of **SCHULTZE**, be unsuitable for use in the device described in the **SCHULZE** reference.

For the foregoing reasons, among others, Applicants' new claims 9 and 10 are believed to be patentable over the **SCHULTZE** and **ROSLING** references, whether taken alone or in combination.

It is accordingly believed that none of the references, whether taken alone or in any combination, teach or suggest the features of claims 9 and 10. Claims 9 and 10 are, therefore, believed to be patentable over the art.

Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

In view of the foregoing, reconsideration and allowance of claims 9 and 10 are solicited.

In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate receiving a telephone call so that, if possible, patentable language can be worked out.

The instant response is being filed simultaneously with a Request for Continued Examination and its associated fee. Additionally, please consider the present as a petition for a two (2) month extension of time, and please provide a two (2) month extension of time, to and including, September 27, 2007 to respond to the present Office Action.

The extension fee for response within a period of two (2) months pursuant to Section 1.136(a) in the amount of \$450.00 in accordance with Section 1.17 is enclosed herewith.

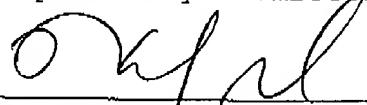
Please provide any additional extensions of time that may be necessary and charge any other fees that might be due with respect to Sections 1.16 and 1.17 to the Deposit Account of Lerner Greenberg Stemer LLP, No. 12-1099.

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Applic. No. 09/761,240  
Response Dated September 27, 2007  
Responsive to Office Action of April 27, 2007

Respectfully submitted,

  
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